

# BIOCHEMISTRY

## **Inorganic** =

- Molecules that do NOT contain carbon chains
- Examples:
  - Oxygen
  - Carbon Dioxide
  - Water

## **Organic** =

- Molecules that contain carbon chains
- Examples:
  - Carbohydrates
  - Lipids
  - Proteins
  - Nucleic Acids
  - ATP

# Inorganic Compounds

- **Oxygen ( $O_2$ )**
  - Essential for most living organisms
  - Involved with the extraction of energy from food molecules
- **Carbon Dioxide ( $CO_2$ )**
  - By-product of the breakdown of food molecules
  - Exhaled during respiration
    - Becomes toxic if allowed to accumulate within cells

- **Water ( $H_2O$ )**

- Important for living organisms because:

1. Stabilizes body temperature
2. Provides protection by acting as a lubricant or cushion
3. Necessary for many chemical reactions
4. Transports many substances

# Organic Compounds: Overview

## *Carbohydrates*

- Elements
  - C, H, O
- Building Blocks
  - Monosaccharides
- Function
  - Energy

## *Lipids*

- Elements
  - C, H, O
  - P, N in some
- Building Blocks
  - Glycerol and fatty acids
- Functions
  - Energy
  - Structure
  - Regulation

## **Proteins**

- Elements
  - C, H, O, N
  - S in most
- Building Blocks
  - Amino Acids
- Functions
  - Regulation
  - Structure
  - Energy
  - Contraction
  - Transport
  - Protection

## **Nucleic Acids**

- Elements
  - C, H, O, N, P
- Building Blocks
  - Nucleotides
- Functions
  - Regulation
  - Heredity
  - Protein Synthesis

# Carbohydrates

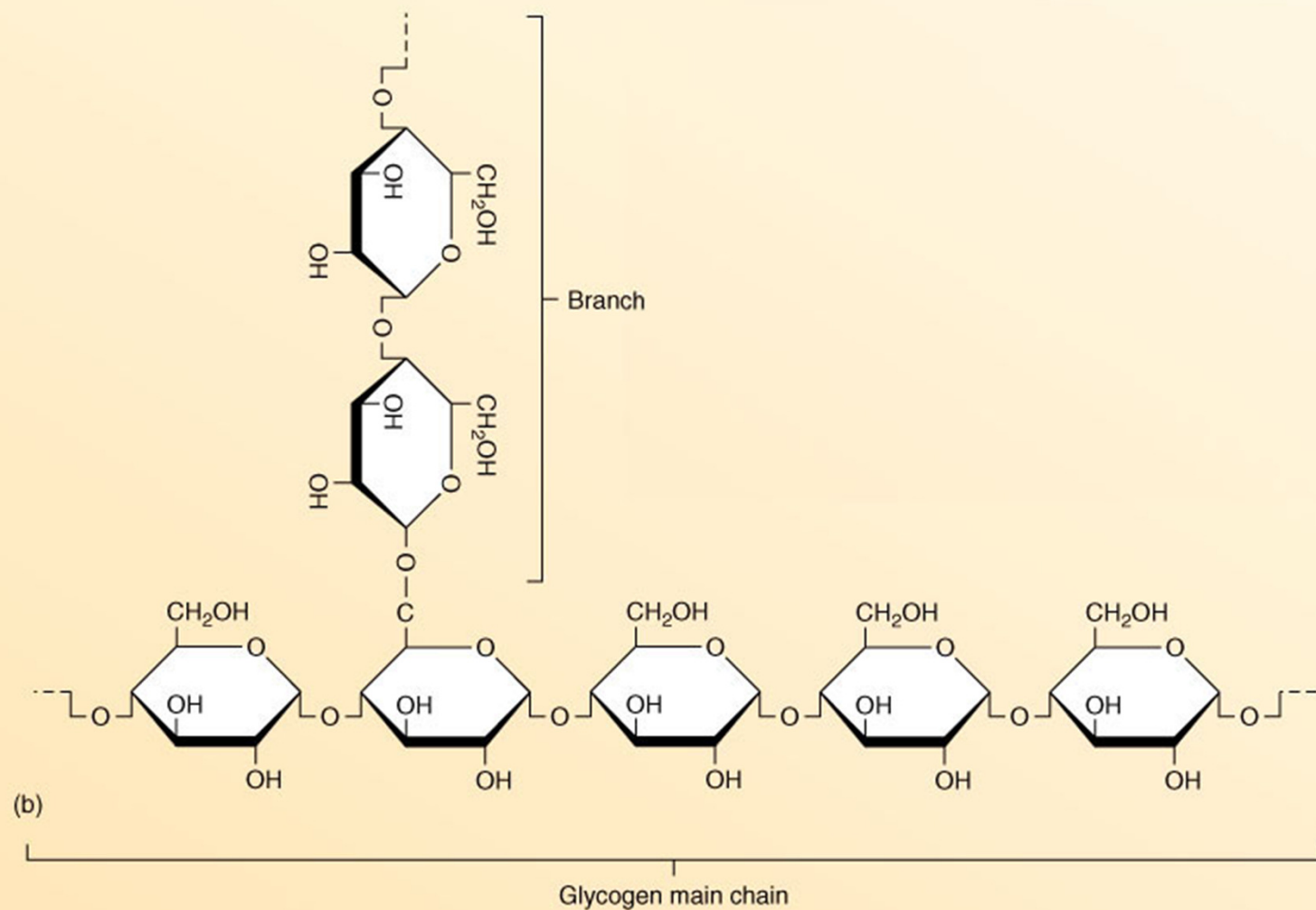
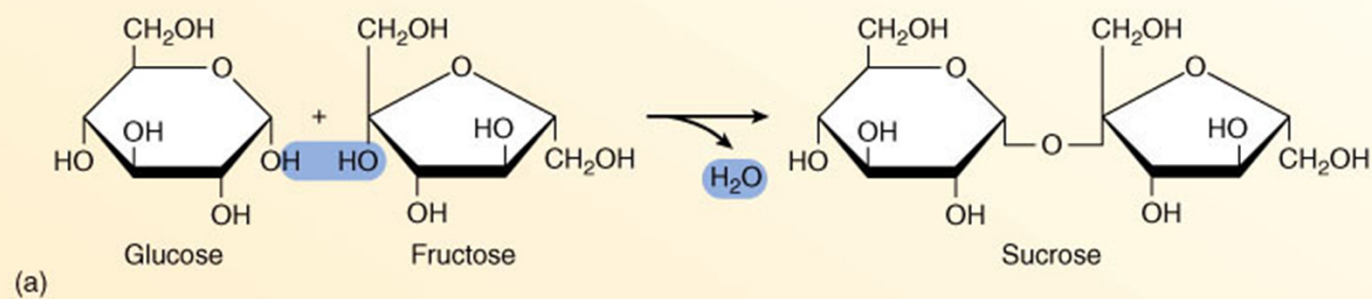
- Sugars are easy for cells to both make and break down
- Convenient way for cells to store chemical **energy**
- Their breakdown provides cells with **energy** for various activities

- **Monosaccharides** =
  - Simple sugars ( $C_6H_{12}O_6$ )
  - Examples
    - Glucose (blood sugar)
    - Fructose (fruit sugar)
    - Galactose (milk sugar)

- **Disaccharides** =
  - Formed when two monosaccharides join
    - Example
      - Glucose + fructose = sucrose (table sugar)



- **Polysaccharides** =
  - Many monosaccharides bound in long chains
  - Examples
    - Cellulose
      - Structural component of plant cell walls
    - Plant starch
    - Glycogen (animal starch)



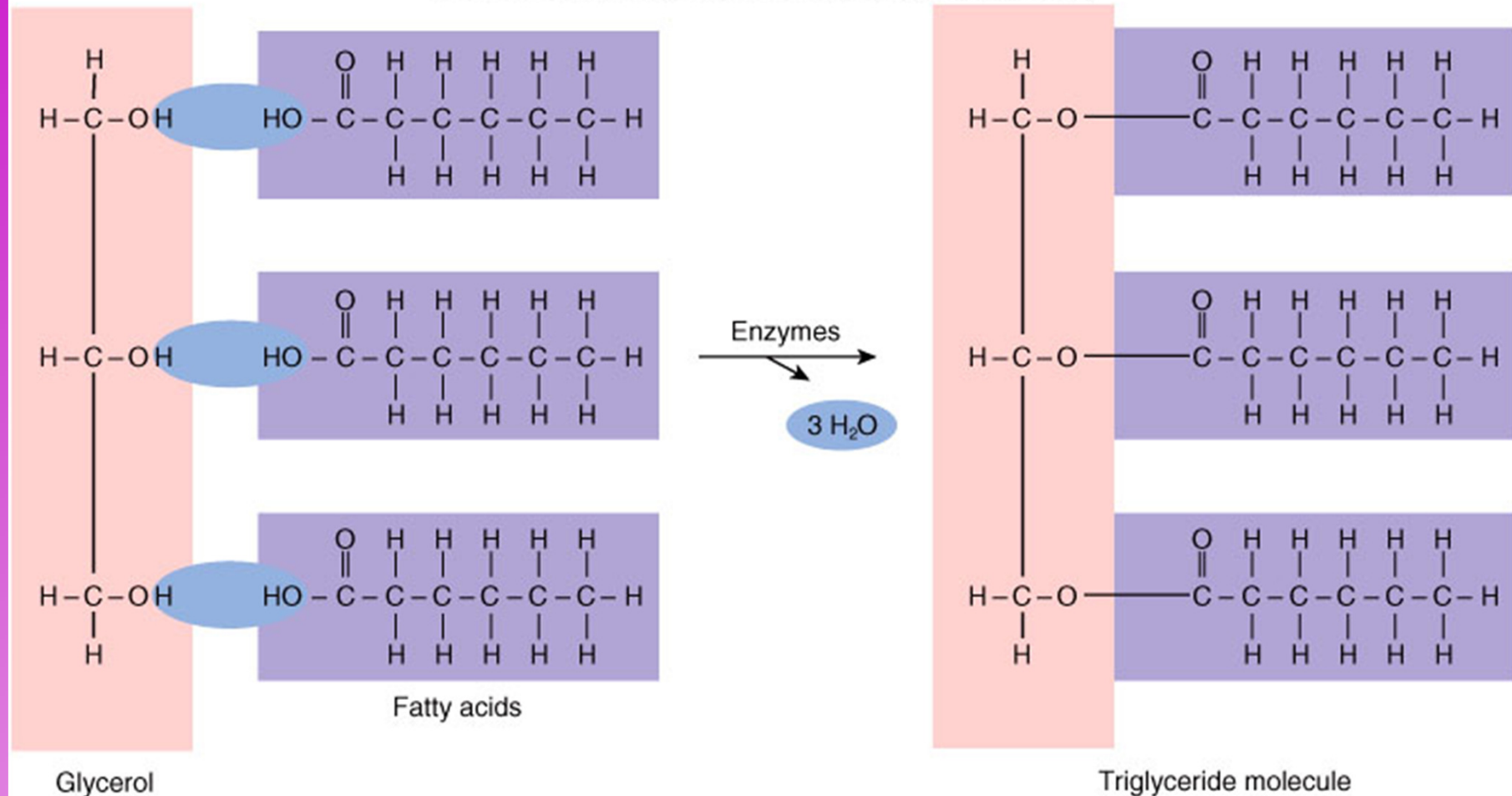
# Lipids

- Dissolve in nonpolar solvents (such as alcohol or acetone) but not in polar solvents (such as water)
- Waxy, fatty, or oily compounds
- Examples
  - Fats
  - Phospholipids
  - Steroids

# ***Fats***

- Important **energy-storage** molecules
- **Pad and insulate** the body
- Building blocks of fats are
  - ***Glycerol***
    - 3 carbon molecule with a ***hydroxyl group*** ( -OH) attached to each C
  - ***Fatty acids***
    - Carbon chain with a ***carboxyl group*** (-COOH) attached at one end

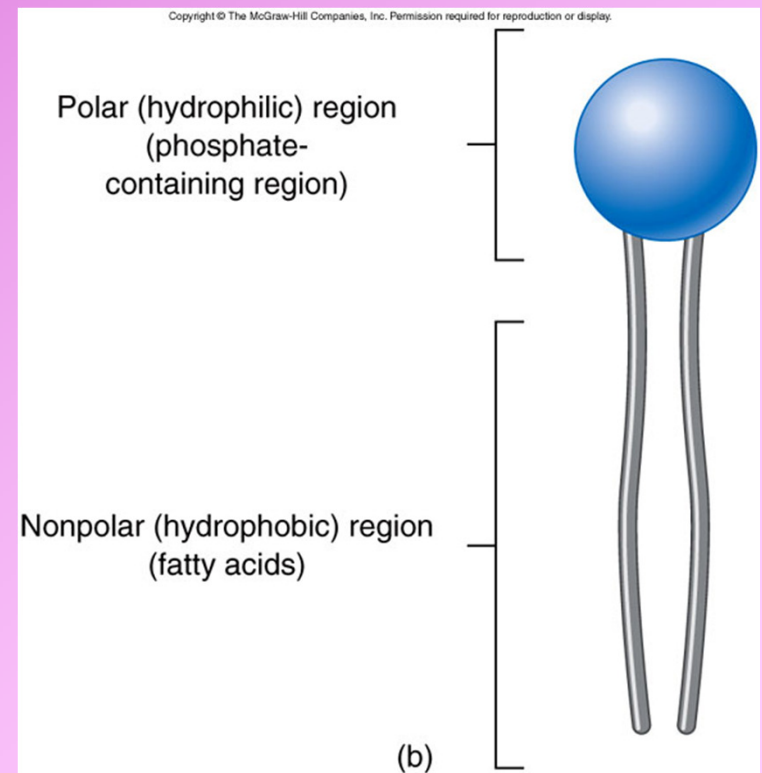
- **Triglycerides** =
  - Most common type of fat molecules
  - 3 fatty acids bound to a glycerol
- **Saturated fats** =
  - Contains only single covalent bonds between carbon atoms
  - Contribute to development of cardiovascular disease



- **Unsaturated fats** =
  - Contain one or more double covalent bonds
  - Best types of fats in the diet
  - **Monounsaturated fats** =
    - Have one double covalent bond between carbon atoms
  - **Polyunsaturated fats** =
    - Have 2 or more double covalent bonds between carbon atoms

# **Phospholipids**

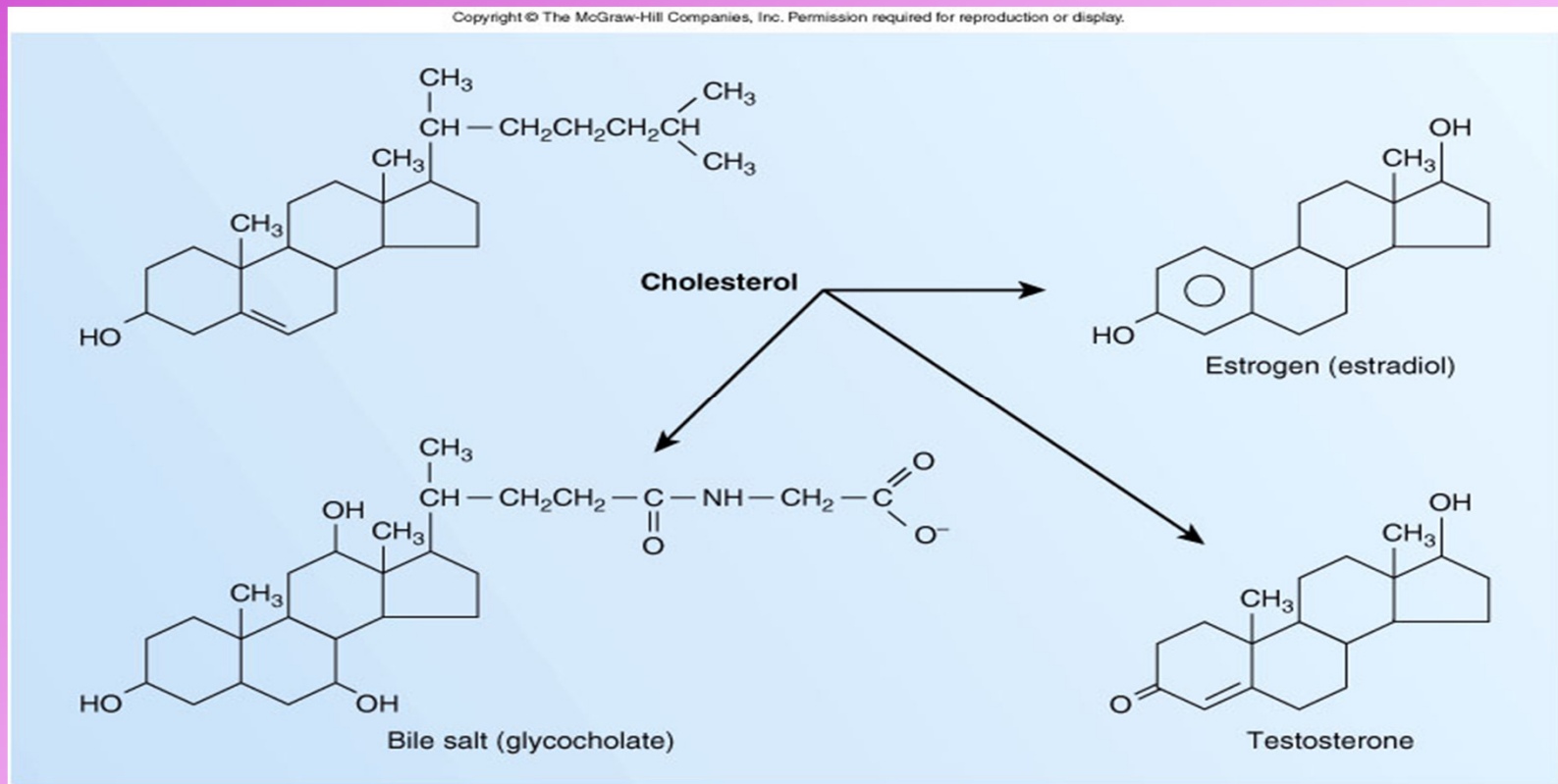
- Important components of **cell membranes**
- 2 fatty acids, glycerol, phosphate molecule
  - Phosphate end is polar and is attracted to water
    - **Hydrophilic** =
      - Water loving
  - Other end is nonpolar and is repelled by water
    - **Hydrophobic** =
      - Water fearing





# *Steroids*

- **Regulate** many physiological processes
- Composed of carbon atoms bound together into 4 ringlike structures



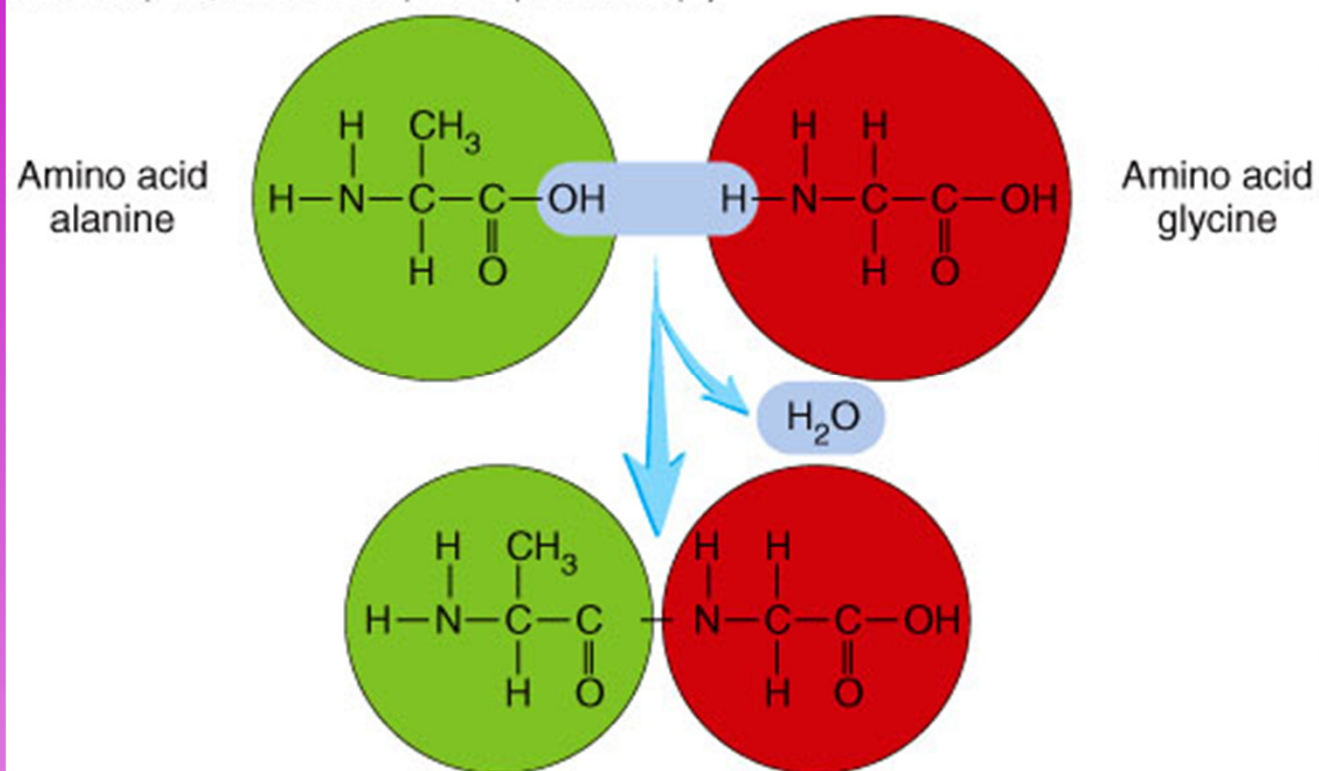
- Examples:
  - Cholesterol
    - Other molecules are synthesized from cholesterol
    - Important component of cell membranes
    - High levels in the blood increase risk of cardiovascular disease
  - Bile salts
    - Increase fat absorption in intestines
  - Reproductive hormones
    - Estrogen
    - Progesterone
    - Testosterone

# Proteins

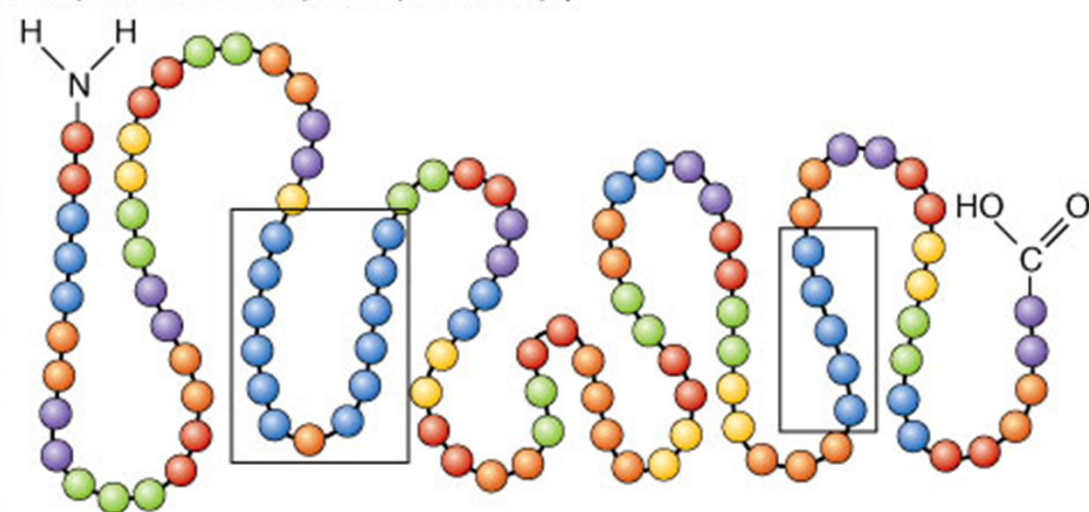
- Important Functions
  - Enzymes- Control the rate of chemical reactions
  - Hormones- regulate physiological processes
  - Collagen fibers- Form structural frameworks
  - Proteins- Can be broken down for energy
  - Actin and myosin- Responsible for muscle contraction
  - Hemoglobin- Transport oxygen in the blood
  - Antibodies- Protect against microorganisms

- Made up of **amino acids**
  - Central carbon bonded to an amine group ( $-\text{NH}_2$ ), a carboxyl group ( $-\text{COOH}$ ), a hydrogen atom, and the “R” group
  - There are 20 basic types of amino acids
- **Polypeptide** =
  - Chain of amino acids

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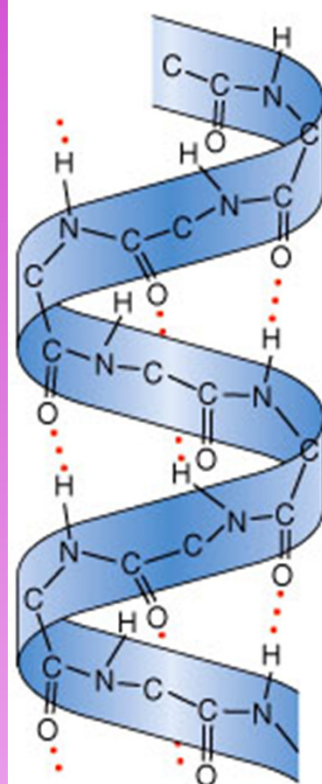
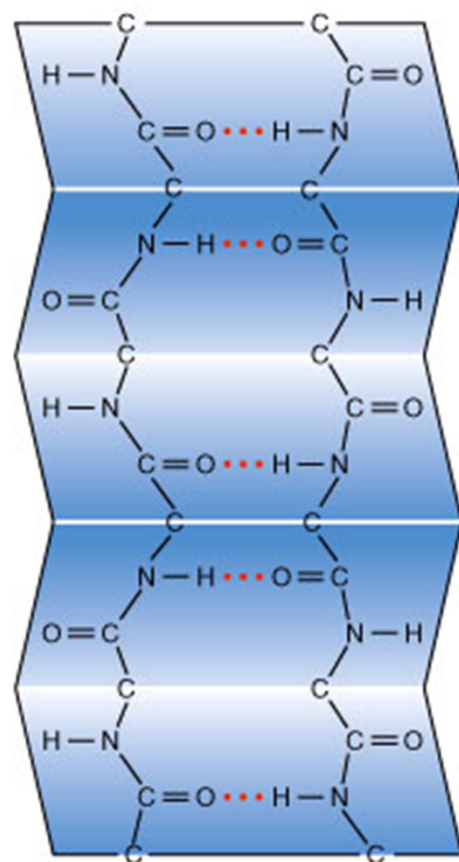


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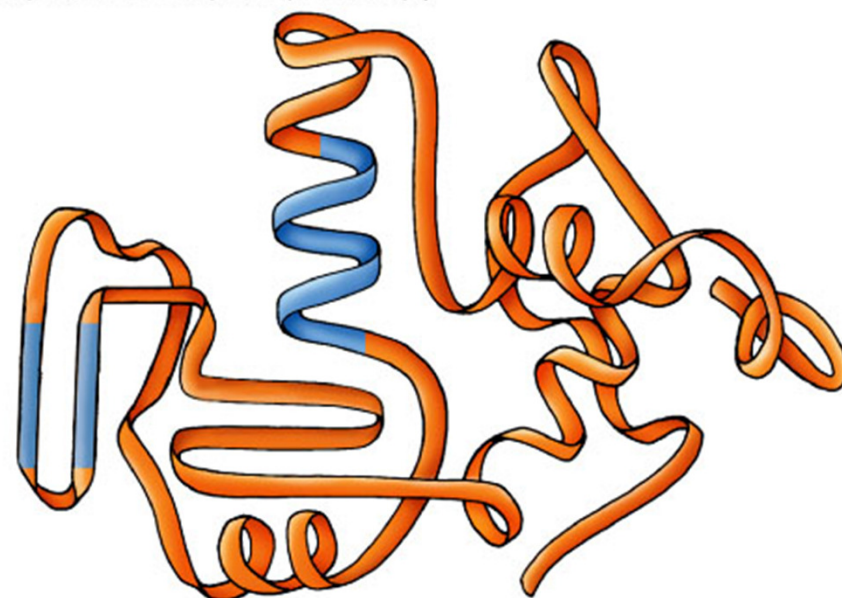


- Fold or coil to form 3-D shapes which is important in performing their functions
- **Denaturation** =
  - The change in the shape of a protein caused by breaking hydrogen bonds
  - Caused by heat or pH change
  - Makes proteins nonfunctional

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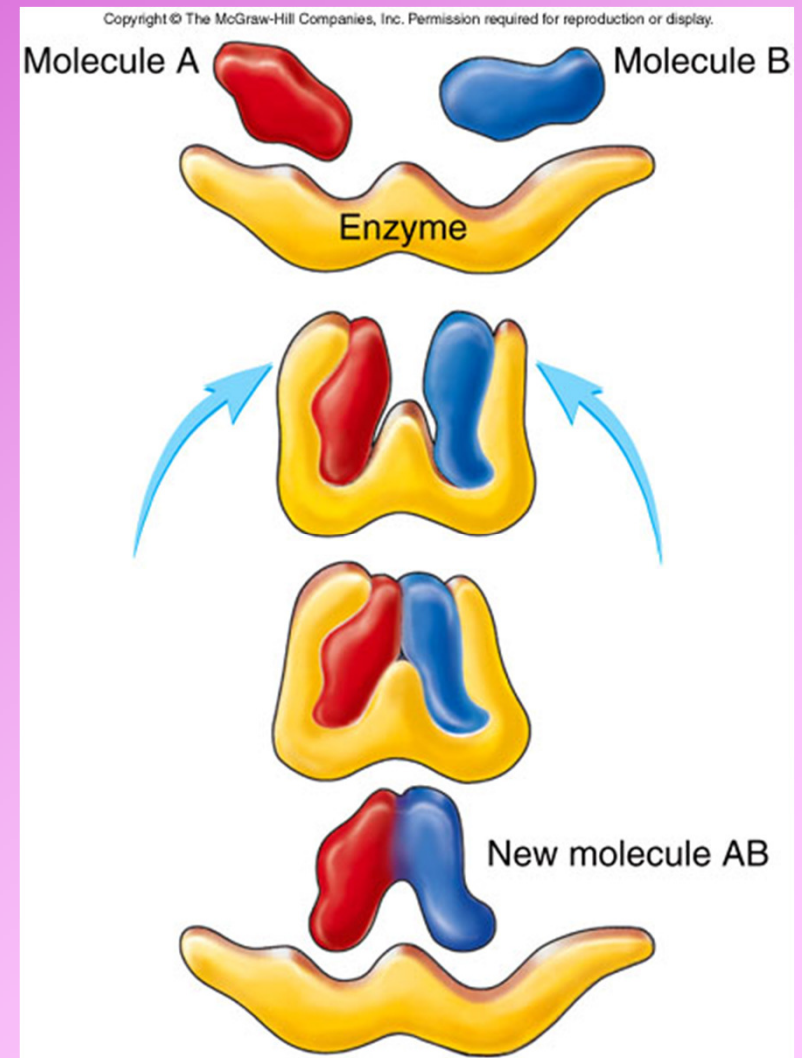


- **Enzyme** =

- Protein catalyst that increase the rate at which a chemical reaction proceeds without the enzyme being permanently changed
- Lower the **activation energy** =
  - Energy necessary to start a chemical reaction



- “Lock and Key” Model =
  - Shape of an enzyme and of the reactants allow the enzyme to bind easily to the reactants
  - Thus enzymes are very specific for the reactions they control





# Nucleic Acids: DNA and RNA

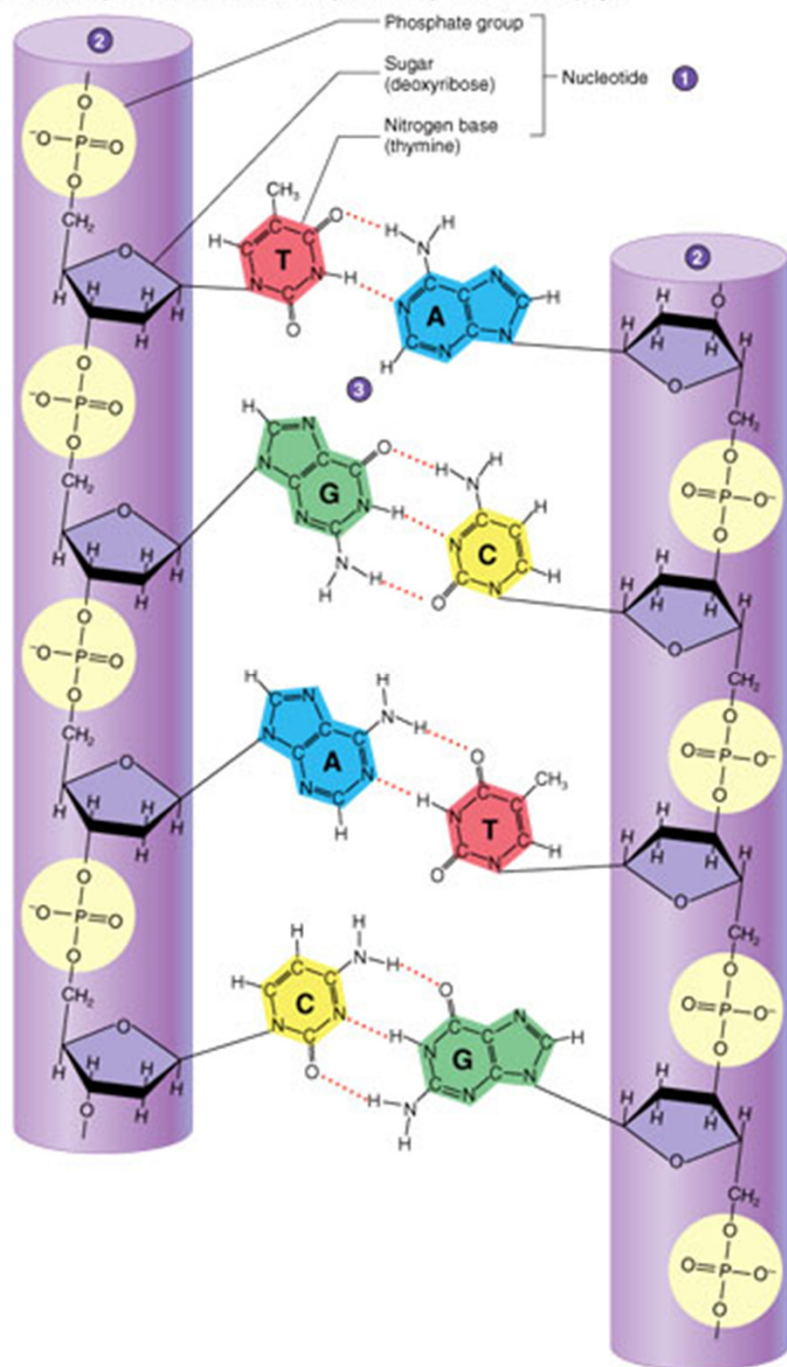
- Information carrying molecules
- 2 types
  - **Deoxyribonucleic Acid (DNA)=**
    - Genetic material of cells
  - **Ribonucleic Acid (RNA)=**
    - Important in protein synthesis

- **Nucleotides** =
  - Basic building blocks of nucleic acids
  - Consist of
    - A sugar molecule
    - A phosphate group
    - Nitrogenous bases

Cytosine (C)      Guanine (G)  
Thymine (T)      Adenine (A)



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## DNA

- Sugar
  - Deoxyribose
- Nitrogenous bases
  - Adenine
  - Guanine
  - Cytosine
  - Thymine
- Double Strand

## RNA

- Sugar
  - Ribose
- Nitrogenous bases
  - Adenine
  - Guanine
  - Cytosine
  - Uracil
- Single Strand
- 3 types
  - Messenger RNA (mRNA)
  - Transfer RNA (tRNA)
  - Ribosomal RNA (rRNA)

# Adenosine Triphosphate (ATP)

- **Stores and provides energy**
- Consists of
  - Adenosine
    - Ribose and Adenine
  - 3 phosphate groups
    - Energy is stored in bonds between phosphate groups
    - Energy is released when that bond is broken

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